PERIODIC HEALTH EXAMINATION, 1995 UPDATE: 2. PREVENTION OF DENTAL CARIES

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Abstract • Résumé

Objective: To make recommendations, based on current evidence, for practising physicians and dentists on interventions for the prevention of dental caries in their patients.

Options: Systemic fluoride administration, professionally administered fluoride, use of fluoride mouth rinses, fissure sealants, oral-hygiene practices, dietary practices, identification of groups at a high risk of dental caries, and early diagnosis and treatment.

Outcomes: Reduced prevalence of dental caries and fluorosis, longer retention of teeth and lower treatment costs.

Evidence: Several MEDLINE searches were conducted for articles published from January 1980 to December 1992, including relevant review articles.

Values: Relevant clinical findings were evaluated and categorized with the use of the evidence-based methods and values of the Canadian Task Force on the Periodic Health Examination. Recommendations were developed for each method of caries prevention, with reduced incidence of dental caries and improved prevalence of caries-free teeth given high values.

Benefits, harms and costs: The potential benefits of these measures in the long term are a lower incidence of tooth decay, longer retention of teeth and prevention of fluorosis. The cost saving can be considerable for patients and insurers; however, implementation of some recommendations will be difficult, since the traditional preventive practices of dentists and dental hygienists are not easily changed.

Recommendations: There is good evidence that the following manoeuvres are effective in preventing dental caries: use of dentifrices containing fluoride, fluoridation of drinking water, fluoride supplements for patients in areas where there is a low level (0.3 ppm or less) of fluoride in the drinking water, professionally applied topical fluoride and the use of fluoride mouth rinses for patients with very active decay or at a high risk of dental caries and selective use of professionally applied fissure sealants on permanent molar teeth. There is poor evidence that the following manoeuvres are effective in preventing dental caries: professionally applied topical fluoride and the use of fluoride mouth rinses for patients with a low risk of caries, toothbrushing (without a dentifrice containing fluoride) and flossing, cleaning of teeth by a dentist or dental hygienist before topical application of fluoride or at a dental visit and di-

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etary counselling for the general population. There is good evidence to recommend against the use of over-the-counter fluoride mouth rinses by the general population.

Validation: These guidelines are compatible with those of the US Preventive Services Task Force.

Sponsor: These guidelines were developed and endorsed by the task force, which is funded by Health Canada. Major funding was provided by the Faculty of Dentistry of the University of Toronto, Toronto, and the Faculty of Dentistry of Dalhousie University, Halifax.

Objectif : Recommander aux médecins et aux dentistes praticiens des mesures de prévention de la carie dentaire chez leurs patients, qui s'appuient sur des preuves actuelles.

Options : Administration générale de fluorure, fluorure appliqué par un professionnel, utilisation des rince-bouche au fluorure, agents de scellement des puits et fissures, pratiques d'hygiène buccale, habitudes alimentaires, identification de groupes à risque élevé de carie dentaire et diagnostic et traitement précoces.

Résultats : Baisse de la prévalence des caries dentaires et de la fluorose, conservation de la dentition pendant plus longtemps et réduction des coûts de traitement.

Preuves : On a effectué plusieurs recherches dans MEDLINE pour y trouver des articles publiés entre janvier 1980 et décembre 1992, y compris des articles pertinents de revues de la littérature.

Valeurs : Les résultats cliniques pertinents ont été évalués et classés à l'aide des méthodes fondées sur la preuve et des valeurs du Groupe d'étude canadien sur l'examen médical périodique. On a formulé des recommandations sur chaque méthode de prévention des caries et accordé des valeurs élevées à la réduction de l'incidence des caries dentaires et à l'amélioration de la prévalence des dents sans carie.

Avantages, préjudices et coûts : Les avantages possibles que ces mesures offrent à long terme sont une baisse de l'incidence des caries dentaires, la conservation de la dentition pendant plus longtemps et la prévention de la fluorose. Les coûts peuvent diminuer considérablement pour les patients et les assureurs, mais certaines recommandations seront difficiles à mettre en oeuvre puisque les pratiques traditionnelles de prévention des dentistes et des hygiénistes dentaires sont difficiles à changer.

Recommandations : Les preuves qui indiquent que les interventions suivantes réussissent à prévenir la carie dentaire sont solides : utilisation de dentifrices au fluorure, fluoruration de l'eau potable, suppléments de fluorure à faible dose pour les patients dans les régions où l'eau potable contient peu de fluorure (0,3 ppm ou moins), application de fluorure topique par des professionnels et utilisation de rince-bouche au fluorure par les sujets atteints de carie très active ou à risque élevé de carie dentaire et application sélective d'agents de scellement sur les molaires permanentes par des professionnels. Les preuves qui indiquent que les interventions suivantes réussissent à prévenir la carie dentaire sont faibles : application de fluorure topique par des professionnels et utilisation de rince-bouche au fluorure par les sujets à faible risque de carie, brossage des dents (sans dentifrice au fluorure) et utilisation de la soie dentaire, nettoyage des dents par un dentiste ou une hygiéniste dentaire avant l'application topique de fluorure ou au cours d'une visite chez le dentiste et conseils en alimentation pour la population en général. Les preuves contre l'utilisation, par la population en général, des rince-bouche au fluorure en vente libre sont solides.

Validation : Ces lignes directrices sont compatibles avec celles du US Preventive Services Task Force.

Commanditaire : Ces lignes directrices ont été élaborées et appuyées par le groupe d'étude, qui est financé par Santé Canada. Le groupe a reçu un financement important de la Faculté d'art dentaire de l'Université de Toronto, à Toronto, et de la Faculté d'art dentaire de l'Université Dalhousie, à Halifax.

Dental caries (commonly known as tooth decay) is a localized, progressive demineralization of the hard tissues of the crown and root surfaces of teeth. The demineralization is caused by acids produced by bacteria, particularly *Streptococcus mutans* and possibly lactobacilli, that ferment dietary carbohydrates. This process occurs within dental plaque, a bacteria-laden gelatinous material that adheres to the surfaces of teeth. Dental caries is a dynamic process; periods of demineralization alternate with periods of remineralization.[1,2] If destruction exceeds repair, a preclinical, demineralized, subsurface carious lesion becomes a frank clinical cavity characterized by a breakdown of surface enamel and extension of the decay into the dentine.

During the last 15 years, significant reductions in the prevalence of dental caries have been achieved in Canada, largely as a result of the use of fluoride. Despite this improvement, caries remains a large problem for a significant proportion of the population. The costs to diagnose, prevent, treat and retreat dental disease, particularly dental caries, are considerable. Canadian dental care costs in 1989 were an estimated $3.1 billion, which is 2.4 times the level of such costs in 1980.[3]

The Canadian Task Force on the Periodic Health Examination wished to provide practising physicians and dentists with up-to-date, evidence-based recommendations for the prevention of dental caries. To provide the basis for these guidelines, recent findings about the diag-

nosis, epidemiologic features, socioeconomic impact and effectiveness of preventive interventions are described. Although many of the interventions discussed are not provided by physicians or allied health care professionals, the interventions provided by physicians and others to prevent dental decay (e.g., fluoride supplementation) must be evaluated in this broader context. Referral to dental services is also an option; therefore, we have provided information concerning which patients are at a high risk of dental caries and which dental services are effective. The clinical options considered were systemic fluoride administration, professionally applied fluoride, use of fluoride mouth rinses, fissure sealants, oral-hygiene practices, dietary practices, identification of groups of patients at a high risk, and early diagnosis and treatment. The effect of these options on the prevalence of dental caries and fluorosis, retention of teeth and cost were evaluated.

This review was based on the results of several MEDLINE searches for articles on dental caries published from January 1980 to December 1992. The values and methods of the task force were used to develop clinical practice guidelines.[4] Two consultants (D.W.L. and A.I.I.) reviewed the literature and provided a written report to all members of the task force. Consensus was then reached on the thoroughness of the review and the grading of the evidence and recommendations.

BURDEN OF SUFFERING

Dental caries is one of the most prevalent infectious diseases of man; it is ubiquitous. It begins soon after teeth erupt, and its prevalence increases with age. Dental caries affects different tooth surfaces at different ages. In children and young adults, the pit-and-fissure (biting) surfaces are mainly affected.[5,6] As people age, the smooth surfaces of their teeth become increasingly susceptible.

Although there are large international and regional differences, the incidence and prevalence of coronal dental caries has declined in industrialized countries over the past 20 years.[5] The prevalence in Canadian children is now 33% to 50% lower than it was 20 years ago, and many children have no tooth decay or fillings.[7] In the United States in 1986 and 1987, 50% of children 5 to 17 years of age had permanent teeth completely free of decay and restorations.[8] The rate of progression of carious lesions through tooth enamel and dentine has slowed as well.[6,9]

There have been small reductions in the number of decayed, missing and filled teeth and in the rate of edentulism (total tooth loss) in adults.[5] Recent reviews show that dental caries, not periodontal disease, is the primary cause of tooth loss in adults.[10,11] Indeed, a study pub-

lished in 1987 showed more continuous coronal caries activity in younger and older adults than was previously believed.[12] The marked improvement in dental-caries status and in retention of teeth among children will eventually become evident in adults as these children grow up. However, there will be a transition period of about 40 years before improvements are evident in all age groups.[13] In older groups the common problems of secondary tooth decay around old fillings, the need for replacement of fillings and breakage of tooth cusps due to extensive fillings have led to a large treatment backlog.

Interest in root caries has increased as a result of longer retention of teeth and the aging of the population. Some authors believe that there will be more root caries in the future because of the increase in the number of retained teeth at risk of periodontal disease with gingival recession.[14] However, others suggest that, even if the absolute prevalence of periodontal recession increases as a result of an aging population, preventive exposure to fluoride will prevent root caries.[15] A secular increase in root caries seems to have occurred; however, the studies evaluating the incidence, prevalence and risk factors of root caries have methodologic problems.[16,17] In the few studies completed, annual incidence rates of 1.6 to 1.8 surfaces with root caries per 1000 surfaces at risk have been reported. A minority (30% to 40%) of the group studied bears the entire burden of root caries. There has been wide variation in the age ranges, the nature of the populations and the proportions of populations with at least one decayed or filled root lesion (21% to 83%) reported in prevalence studies.[16–18]

The extensive decline in the incidence of dental caries has not benefited all children equally. US data show that 20% to 25% of children — the so-called "high-risk" children — have high levels of tooth decay.[19] Two recent clinical trials that investigated children in Ontario at high risk of dental caries found levels of tooth decay similar to those reported years ago.[20,21] Such children 6 to 7 years of age had 11 or 12 decayed, missing or filled tooth surfaces per child on average, and those 10 to 11 years of age had 9 or 10 such surfaces per child on average.

Detailed reviews of the many risk factors and risk indicators for dental caries have been reported elsewhere.[22–24] Children and adults with certain medical problems are at a higher risk of dental caries than their peers. These problems include bulimia, Sjögren's syndrome, radiation therapy directed to the head or neck, chemotherapy, or prolonged use of drugs that reduce the flow of saliva.[25] People living in an institution and those with physical and mental disabilities are also at higher risk than others.[22–24]

Age,[24] socioeconomic disadvantage[23] and previous

dental caries[24] are strongly linked with the incidence of dental caries. Although past research showed that eating sugar was a definite risk factor,[26,27] current research findings concerning the effect of contemporary dietary practices on dental caries have been equivocal.[23,28,29] However, this research does show that people with a high sugar intake and poor oral hygiene may be at high risk of dental caries.

No single salivary factor yet identified has good predictive values for dental caries, although salivary flow rate and buffering capacity may prove to be risk indicators.[24,25,30–32] The incidence of coronal dental caries is associated with the initial presence of Streptococcus mutans in dental plaque and with the presence of lactobacilli in later stages of caries.[30,31] Table 1 lists groups considered, from a clinical perspective, to be at a high risk of dental caries.

Nursing caries, also called baby-bottle tooth decay, is a specific form of severe decay that affects the primary teeth of infants in a very characteristic manner.[33] Nursing caries occurs rapidly and affects the upper, but not the lower, anterior primary teeth and some posterior teeth. The prevalence is particularly high in aboriginal populations,[34] but in the general population it is no higher than 5%.[33] Numerous case reports suggest that the main cause of this severe decay is exposure to almost any sugary liquid (including milk, formula, fruit juices and sweetened liquids) for long periods, such as occurs during nocturnal bottle feeding of babies.[33] In case–control studies the odds ratio for nursing caries from nocturnal bottle feeding is estimated at between 7 and 32.[35,36] However, owing to the design of these studies, the overall evidence for this association is weak.

Table 1: Groups potentially at a high risk of dental caries

Medical factors
Patients
- with diseases, such as bulimia, Sjögren's syndrome, rheumatoid arthritis, diabetes mellitus or pernicious anemia, that alter the flow rate or content of saliva,
- receiving chemotherapy with drugs that cause xerostomia, or
- receiving radiation therapy directed to the head or neck.

Lifestyle factors
Patients with
- inadequate dietary habits and
- very poor oral hygiene.

Dental factors
Patients with
- previous dental caries who are less than 5 years of age,
- previous dental caries on surfaces of anterior teeth,
- active carious lesions that develop between recall examinations,
- a higher than average number of decayed, missing and filled teeth on approximal surfaces of posterior teeth,
- gingival recession or root caries, or
- high levels of cariogenic bacteria (e.g., more than 750 000 colony-forming units [CFU] of Streptococcus mutans and more than 100 000 CFU of lactobacilli per millilitre of saliva).

EFFECTIVENESS OF EARLY DIAGNOSIS AND TREATMENT

Traditionally, the clinical detection of carious lesions on the crowns of teeth has involved the use of a sharp explorer, a viewing mirror and an artificial light source as well as the drying of tooth surfaces to improve visibility. This visual and tactile approach is often supplemented by the use of selected radiographs or fibreoptic illumination to help diagnose small incipient carious lesions on the hidden surfaces between adjacent teeth. The early clinical detection of incipient carious lesions has aroused interest recently because of the possibility that primary prevention (e.g., through the use of topical fluoride) may enhance remineralization and even arrest decay.[37,38] The benefits of detection and focused prevention procedures, rather than global prevention, have not been evaluated in a clinical trial. However, because the prevalence of caries in some age groups has declined substantially over the past 20 years and the level of caries varies widely from person to person, there is now a justifiable emphasis on individualizing the frequency and content of recall examinations, rather than conducting such examinations routinely at fixed intervals.[39]

Visual detection of advanced coronal decay, with subsequent histologic determination as the gold standard, has a sensitivity of 84% and a specificity of 78% for pit-and-fissure surfaces and predictive values of a positive test of 92% and of a negative test of 63% (unadjusted for current prevalence).[40] For the use of radiographs to diagnose small cavities between the teeth, a sensitivity of 98% and a specificity of 36% and unadjusted predictive values of a positive test of 97% and of a negative test of 53% have been reported.[41]

In view of the wide spectrum of risk indicators for caries, it is not surprising that various simple tests for susceptibility to dental caries involving single predictors[25,30,31] and, more recently, multiple predictors[17,23,42,43] have been developed. None of these methods has succeeded in predicting the risk of all types of caries for individual patients, although in prediction of caries on root surfaces results were more promising.[17,43]

In fact, the diagnosis of dental caries in clinical practice is idiosyncratic and plagued by considerable variation among practitioners.[44–46] Studies have shown variation among dentists in their development of plans for restorative care after examining the same group of patients[44] and in their interpretations and treatment decisions concerning dental caries when examining the same set of radiographs.[45] In a Scottish study in which 15 dentists examined 18 young adults, the probability of agreement between two dentists selected at random about filling a particular surface was only 0.4.[46] There was a fivefold difference in the cost of the planned treatment between two of the dentists.

Secondary prevention of dental caries involves the replacement of destroyed tooth tissue with various types of restorations to prevent further destruction. This aspect of prevention will not be discussed further, except to note that full restoration of incipient lesions should be discouraged in favour of small, noninvasive, resin restorations in pits and fissures or intensive primary prevention with fluoride to enhance remineralization of smooth tooth surfaces. Tooth restoration appears to lead to a lifelong cycle of replacement fillings, each of which is slightly larger than the one it replaces; this should be avoided if possible.[47]

EFFECTIVENESS OF PRIMARY PREVENTION

Four major types of primary prevention will be reviewed briefly: fluoride therapy, fissure-sealant therapy, dietary counselling and oral-hygiene measures.

FLUORIDE

Use of fluoride is the most effective measure for primary prevention of dental caries. Drinking-water fluoridation remains the single most effective, equitable and efficient means of preventing coronal and root dental caries. This remains true despite the apparently reduced effectiveness of fluoridation (reductions in the incidence of decay — of about 50% previously — are now 20% to 40%) and the widespread availability of fluoride in foods, drinks, vitamin supplements and dental products.[19,48] The effect of drinking-water fluoridation on coronal decay in children, adolescents and adults has been studied in numerous community trials and economic evaluations;[19] its effect on root caries has been evaluated in case–control studies.[49] In areas with lower fluoride concentrations than the optimal level (0.7 to 1.2 ppm) in the drinking-water supply, prescription of fluoride supplements is recommended by the Canadian Paediatric Society[50] and others, although compliance may be difficult to assure.[51]

In order to protect teeth, fluoride must be loosely bound and freely available in the oral environment. Free fluoride ions combine with the hydroxyapatite crystal of the tooth to form a complex that is more resistant to demineralization than the crystal alone. Fluoride ions also have a strong influence on the arrest and healing of early carious lesions by bonding with the calcium and phosphate ions lost from teeth after an acid attack.

Because of the widespread availability of fluorides, there is now concern about increases in the prevalence of fluorosis in the teeth of children, although such fluorosis is usually very mild.[52,53] Dental fluorosis is visible as soon as the tooth erupts and results from the incorpora-

tion of too much fluoride into the calcium hydroxyapatite crystals of enamel. This can be caused by exposure to higher concentrations of fluoride than the optimal level (0.7 to 1.2 ppm), which can occur when a child ingests fluoride supplements, toothpaste and fluoride from other sources. In mild cases of fluorosis the tooth appears to have white lines scattered irregularly on its surface. In more severe cases hydroxyapatite crystals may fail to form during enamel mineralization, which leaves voids or spaces inside the enamel; the teeth may have white areas or appear stained, eroded or pitted. In children, fluorosis appears most frequently as "snowcapping," a parchment-white-coloured area on the incisal or occlusal surface of the tooth that resembles the snow caps on mountains. By the time the physician or dentist recognizes fluorosis in the permanent teeth, it is too late to prevent its appearance on most of the other teeth, including those yet to erupt, because fluoride has already been incorporated into their enamel. Therefore, providing the appropriate amount of fluoride during the first 6 years of life is the best method to prevent both caries and fluorosis.

The observed increase in fluorosis has been attributed to inappropriate prescribing of fluoride supplements by dentists and physicians[54,55] or overzealous use of these supplements at the urging of parents or both.

To reduce the unnecessary risk of fluorosis, guidelines of the Canadian Workshop on the Evaluation of Current Recommendations Concerning Fluorides[56] recommended that the schedule for dietary fluoride supplementation be modified to prevent the condition (Table 2). These guidelines have not been evaluated in clinical practice but were officially sanctioned in 1993 by the Canadian Dental Association on the basis of expert opinion. They have not been adopted by other health care organizations.[50] Local health units should be consulted regarding appropriate supplement dosages.

Professionally applied topical fluoride, mainly acidulated phosphate fluoride (APF) gel, continues to be popular. It has proven to be efficacious on the basis of randomized controlled trials (RCTs) involving children, although there have been few trials of this agent involving a placebo control since 1980, the beginning of the era of the decline in the incidence of caries.[57]

There are three issues for consideration in the use of topical fluoride. First, several recent RCTs have shown that the traditional prophylaxis (cleaning) of the teeth before professional application of topical fluoride is not efficacious in reducing decay.[57] This prophylaxis takes up about two-thirds of the total time for the procedure; hence, topical fluoride application without prophylaxis is equally efficacious but less costly.

Second, the recommended frequency of professional

application of topical fluoride — biannual rather than annual — is not as well studied as conventional wisdom would lead one to believe.[57] There is only one RCT, published in 1971, in which the use of a fluoride agent — APF solution — was tested annually and biannually.[58] The additional absolute savings, in terms of decayed, missing or filled tooth surfaces, of biannual over annual application was not clinically important, statistically significant or cost effective. Similarly, an RCT conducted in Ontario found no significant effect of biannual over annual applications, with or without prior prophylaxis, after 3 years of treatment.[21]

Third, several studies have shown that the retention and swallowing of fluoride, especially by young children, after professional application of topical fluoride is surprisingly high.[52] Thus, careful technique and the use of conservative amounts of fluoride gel are very important.

Today, costly professional topical application of fluoride cannot be recommended for most children, especially in communities with water fluoridation,[57] because the decline in the incidence of dental caries makes such treatment unnecessary. However, this form of fluoride therapy is recommended for patients with active decay, those at a high risk of caries, those undergoing radiation therapy directed to the head and neck, and older adults with root caries.[57]

Self-applied fluorides, such as the almost universally

Table 2: Recommendations on fluoride supplements from the Canadian Workshop on the Evaluation of Current Recommendations Concerning Fluorides[56]

Fluoride supplements
- should *not* be recommended for children less than 3 years of age,
- should be targeted to individuals or groups at a high risk of dental caries,
- should be sold only in a chewable or lozenge form, as a behind-the-counter product,
- should *not* be recommended in areas with fluoridated drinking water and
- should be packaged with a written dosage regimen.

Use of fluoride supplements may be appropriate for targeted individuals and groups and for children 3 years and older in areas with 0.3 ppm or less fluoride in the drinking water. Evaluation of all fluoride intake from ingested fluids should be considered before supplements are used.

Estimation of the mean amount of fluoride ingested from all fluid sources should take into account all home and child-care water sources as well as the effect of water filtration devices in the home.

Manufacturers should be formally requested to formulate proper dosage regimens for chewable fluoride and multivitamin supplements.

Recommended fluoride dosages for areas with 0.3 ppm or less fluoride in the drinking-water supply:
- For children 3 to 5 years of age, 0.25 mg/d
- For children 3 to 5 years of age who do not use fluoride toothpastes regularly, 0.50 mg/d
- For children 6 years of age or older, 1.00 mg/d

used fluoride dentifrices, are strongly recommended because of their ease of use, low cost and effectiveness in preventing coronal and root caries, as shown by RCTs.[57,59] The decline in the incidence of caries in developed countries during the past 15 to 20 years is invariably ascribed to the use of fluoride toothpastes. However, the concern about the increased incidence of mild fluorosis has prompted recommendations for more cautious and supervised use of fluoride dentifrices, particularly by young children.[52,56,60]

Although a daily fluoride mouth rinse containing 0.05% sodium fluoride and a weekly rinse containing 0.2% sodium fluoride were previously shown to be effective in school-based, supervised trials,[57] a more recent Canadian trial involving schoolchildren 9 to 11 years of age in communities with fluoridated and unfluoridated water showed no significant effect of mouth rinses.[61] In recent years, low-potency over-the-counter fluoride mouth rinses have been marketed, but there is insufficient data on their effect on caries.[60] None of these fluoride rinses is intended for children under 5 years of age.[57] As a result of the decline in the incidence of caries and the concerns about excessive ingestion of fluoride, fluoride mouth rinses are now recommended only for those at high risk of dental caries and those who do not regularly use a fluoride dentifrice.[62]

FISSURE SEALANTS

Fissure sealants are resins applied by dental personnel to the pit-and-fissure surfaces of the posterior and lingual pits of anterior teeth, where the most common form of decay occurs. Such sealants have been extensively studied in RCTs since 1979 and have proven effective in reducing this surface decay.[7,63,64] Because of the high cost of sealants, the general decline in the incidence of caries and the differing tendencies of fissures to decay, sealants should be applied selectively in patients at a high risk of caries, to permanent molars only, within 2 to 3 years of tooth eruption[7] (this time frame is subject to corroboration[65]). The median retention time for sealants is about 7 years.[64] Recent longitudinal studies have also shown the effectiveness and safety of using sealants, rather than traditional amalgam fillings, to treat small carious lesions.[63,65] The diffusion of sealant use in general dental practice has generally been poor, despite the evidence of the efficacy of this treatment.[7]

DIET AND ORAL HYGIENE

Dietary counselling to encourage patients to reduce their sucrose intake and use substitutes that are safe for their teeth may not be needed for most patients. Two recent longitudinal studies of diet found that the incidence

of dental caries among children was low despite their high sugar consumption.[28,29] Furthermore, the effectiveness of dental counselling in changing overt behaviour is suspect.[66]

Since sugars are a cause of caries,[1] selective counselling, limited to children at a high risk of caries, may still be indicated. Because of the risk of severe decay of infants' teeth,[33,35,36] the nocturnal or other prolonged use of baby bottles containing liquids other than water is not advised;[33] however, the effect of counselling on this practice has not been evaluated.

Oral-hygiene practices consist of plaque removal by toothbrushing and flossing and the professional prophylaxis that often precedes a periodic dental examination. There is no evidence that these measures, as ordinarily practised, lead to reductions in the incidence of caries.[23,25,67] Daily personal oral hygiene (toothbrushing and flossing) is recommended in the interests of good hy-

Table 3: Summary of manoeuvres, effectiveness, levels of evidence and recommendations for the prevention of dental caries

Manoeuvre	Effectiveness	Level of evidence*	Recommendation*
Drinking-water fluoridation (1.0–1.2 ppm)	Reductions in the incidence of dental caries of 20% to 40% have been reported	Prevention of coronal caries: well-designed and controlled community trials without randomization[19,48] (II-1) Prevention of root caries: case–control study[49] (II-2)	Good evidence that water fluoridation is the most effective, equitable and efficient preventative for coronal and root dental caries (A)
Daily fluoride supplementation (only where fluoride levels in drinking water are 0.3 ppm or less)	Reductions in the incidence of caries in children similar to those achieved by drinking-water fluoridation have been reported; however, parent compliance in providing children with daily supplements is poor	Nonrandomized controlled trials[51,56] (II-1). The new lower dosage schedule approved by the Canadian Dental Association has not been subjected to clinical trials	Good evidence of reductions in the incidence of decay if the proper dosage schedule is carefully followed; however, inappropriate prescribing of excess fluoride supplements is the main factor in recent increases in the incidence of fluorosis (A)
Annual or biannual professional application of topical fluorides such as acidulated phosphate fluoride gel†	This is a labour-intensive and expensive procedure that is not effective and efficient for most patients in communities with fluoridated or nonfluoridated drinking water. It is effective if used selectively	Prevention of coronal caries: randomized controlled trials (RCTs) involving mainly children and adolescents and conducted before the incidence of caries had declined[57] (I) Prevention of root caries and excess caries resulting from reduced salivary flow caused by radiation therapy or chemotherapy: professional opinion[57] (III)	Good evidence to support this procedure for those with very active decay or at a high risk of caries, since caries in these groups mimics that in the general population before the incidence of caries had declined (A) Poor evidence to include this procedure in periodic dental examinations for the general population, but it may be recommended for individual patients on other grounds (C)
Prophylaxis (cleaning) before professional application of a topical fluoride	Study results show that the incidence of dental caries is equivalent with or without prophylaxis	RCTs[21,57] (I)	Good evidence to recommend that such prophylaxis be excluded from periodic dental examinations (E)
Use of fluoride mouth rinses (containing 0.20% sodium fluoride, weekly, or 0.05% sodium fluoride, daily)	Statistically and clinically significant reductions in the incidence of caries were previously reported; however, in an era of declining incidence, the effectiveness of this procedure for most children is questionable	Older, randomized trials involving schoolchildren and more recent trials[57,62] (I) Recent over-the-counter fluoride mouth rinses for home use have not been well evaluated[60] (III)	Good evidence for use of this manoeuvre for those with very active decay or a high risk of caries (A) Poor evidence to recommend this manoeuvre for the general population, but it may be recommended for individual patients on other grounds (C) Good evidence to recommend against the home use of over-the-counter fluoride mouth rinses for the general population (E)

*For descriptions of levels of evidence and classification of recommendations see Appendix 1 in part 1 of the 1992 update (*Can Med Assoc J* 1992; 147: 443).
†The recommendations for the use of this manoeuvre in the general population and in groups at high risk differ. Despite older randomized controlled trials supporting the use of this manoeuvre, routine use for the general population is now problematic as a result of the decline in the incidence of caries.

giene, because of its effect on the esthetic appearance of teeth and on gingival disease, and as a vehicle for the application of fluoride dentifrice, a proven caries preventative.

RECOMMENDATIONS (TABLE 3)

There is good evidence from nonrandomized trials[19,48] that drinking-water fluoridation prevents dental caries (grade A recommendation). There is good evidence to recommend the use of fluoride toothpastes on the basis of RCTs[57,59] and the use of fluoride supplements of appropriate dosages on the basis of nonrandomized controlled trials (grade A recommendations).[51,56] For patients with very active decay or at a high risk of caries, there is good evidence from RCTs[57] to recommend professional topical application of fluorides and the use of fluoride mouth rinses (grade A recommendation).[57,62] However, there is poor evidence (grade C recommendation) for or against

Table 3 continued			
Manoeuvre	Effectiveness	Level of evidence*	Recommendation*
Use of self-applied fluoride dentifrices†	Daily use results in statistically significant reductions in the incidence of decay. This is an important self-applied source of fluorides, since about 90% of dentifrices sold contain fluoride	Older clinical trials (coronal caries) and one recent trial (root caries)[57,59] (I)	Everyone should use a fluoride dentifrice daily as part of regular oral hygiene; care should be taken, and supervision of toothpaste use by young children is required, to prevent swallowing of excess toothpaste (A)
Daily plaque removal by toothbrushing and flossing‡	Although daily toothbrushing and flossing do not prevent caries, they are part of good oral hygiene and help to control gingival disease	Professional opinion and descriptive studies[23,67] (III) Evidence is from studies involving only very young children[67] (II-1)	Poor evidence to recommend this manoeuvre strictly for caries prevention; however, toothbrushing is essential for self-application of a fluoride dentifrice, which is a grade A recommendation (C)
Prophylaxis (cleaning) during periodic dental examinations‡	Traditional dental prophylaxis is not effective in preventing caries, but it may be used to remove stain or calculus. Daily personal oral hygiene (toothbrushing and flossing) may prevent staining and calculus build-up	RCTs, some of which included the use of fluoride pastes[67] (I)	Poor evidence to include prophylaxis in recall dental visits strictly to prevent caries, but it may be recommended for individual patients on other grounds (C)
Fissure sealants	Decay of pit-and-fissure surfaces is significantly statistically and clinically reduced if such sealants are used selectively	RCTs[7,63,64] (I)	Good evidence for selective use on permanent molars within 3 years of eruption in children at high risk of caries (A)
Counselling patients to reduce intake of cariogenic foods	Despite early evidence, recent data suggest that dietary sugars do not have a major effect on the incidence of caries	One trial involving patients in an institution (II-1). Recent cohort studies[28,29,66] (II-2)	Poor evidence of effectiveness of changes in diet for the general population and of the effectiveness of dental counselling in inducing changes in diet; however, counselling is recommended for patients at a high risk of caries (C)
Counselling patients to reduce nocturnal and long-term feeding with baby bottles containing liquids other than water	Bottle feeding with sugary liquids for long periods is the main cause of nursing caries; however, the effectiveness of counselling patients to change this practice has not been evaluated	Case–control studies[35,36] (II-2)	Counselling patients to change infant-feeding practices to prevent caries is recommended (C)

‡Effectiveness, evidence and recommendations for this manoeuvre refer to prevention of dental caries only; the evidence and recommendations concerning prevention of periodontal disease may be different.

the professional topical application of fluorides or the use of fluoride mouth rinses for the general population. Furthermore, there is good evidence from recent RCTs[21,57] not to recommend professional prophylaxis (cleaning) before the professional topical application of fluorides and good evidence not to use over-the-counter fluoride mouth rinses (grade E recommendations).[60] There is poor evidence from RCTs[67] to support the inclusion in dental recall visits of cleaning to prevent caries (grade C recommendation), but it may be recommended selectively to prevent gingivitis and periodontitis.

There is poor evidence to support daily brushing and flossing strictly to prevent caries (grade C recommendation);[23,67] however, brushing is essential for applying fluoride dentifrice to teeth, and brushing and flossing are recommended to prevent gingivitis.

There is good evidence from RCTs for the selective use of fissure sealants on the recently erupted permanent molars of children at a high risk of caries (grade A recommendation).[7,63,64]

There is poor evidence on which to evaluate counselling patients to change their diet[28,29,66] or to refrain from long-term use of baby bottles containing liquids other than water.[33]

Almost all of these recommendations differ from those in the task force's 1980 report.[68]

As a result of the changing epidemiologic patterns of dental caries and the need for efficiency in dental services, the use of dental-caries preventatives should be more selective and targeted to groups at a high risk of caries. It is impossible to estimate the benefit that would result from these recommendations, since such a benefit would be realized only after the long-term use of the preventive interventions. However, we believe that the recommended manoeuvres could reduce the incidence of dental caries by 20% to 50%. If fluoride is used appropriately, the prevalence of fluorosis should not be more than 10%, and any resulting fluorosis should be very mild.

PRIORITIES FOR RESEARCH

Methods of identifying early carious lesions accurately and of identifying people at a high risk of dental caries are required. Also needed are studies aimed at defining appropriate restorative care and guidelines for restorative decision making. Research is needed to confirm the relation between the vulnerability of occlusal surfaces to caries and the time since tooth eruption. Prospective studies to examine all possible factors associated with nursing caries are also needed. Since many different dental caries preventatives have proven effective, research into the most effective and efficient combinations of preventive interventions, and the optimal fre-

quency of their use, is important. In light of the ubiquitous availability of fluorides and the increased incidence of mild fluorosis, the best use of systemic and topical fluorides to achieve the maximum reduction of the incidence of caries and the minimum prevalence of fluorosis should be determined.

VALIDATION

Drafts of this article were reviewed on three occasions by the members of the Canadian task force, by four of Canada's top dental epidemiologists and preventive dentistry teachers, and by a designate of the primary author of the dental caries report of the US Preventive Services Task Force. All changes suggested by these reviewers that were consistent with the evidence and the required review format were made.

The recommended actions for physicians and nurses listed in Table 4 are compatible with those issued by the US Preventive Services Task Force.[69] The recommendations on fluoride use are identical to the guidelines from the Canadian Workshop on the Evaluation of Current Recommendations Concerning Fluorides.[56,70]

Table 4: Recommended actions for physicians and nurses to prevent or treat dental caries

When taking histories, enquire about patients' last dental examination and suggest that those visiting the dentist irregularly make a dental appointment.

Examine the teeth for obvious untreated tooth decay and recommend prompt attention to any carious lesions observed.

If a patient has rampant caries, recommend consultation with a dentist about treatment with sealants, decreased consumption of sugary snacks, and use of fluoride dentifrices and other sources of fluoride.

Recommend to patients that the toothbrushing by small children be supervised and that only a small, pea-sized amount of fluoride dentifrice be used.

Recommend against the use of baby bottles that contain sweetened liquids, particularly at bedtime.

Consult with the patient's dentist about the special preventive needs of patients with bulimia or Sjögren's syndrome, receiving radiation therapy directed to the head or neck or chemotherapy, and using drugs that reduce salivary flow.

Recommend fluoridation of the community drinking-water supply if it is fluoride-deficient.

Before prescribing fluoride supplements for infants and young children living in communities with fluoride-deficient drinking-water supplies, check the fluoride content of all ingested fluids and pay careful attention to the dosage of fluoride prescribed (see recommended dosages in Table 2).

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